REMARKS

Reconsideration and allowance are respectfully requested.

Claims 1, 4-9, 12-13, 15, 18-24 and 28-29 are pending. The claim amendments are fully supported by the disclosure as originally filed and, thus, no new matter is added by their entry. For example, typographical errors, improper English grammar or idiom, and other informalities (including mistranslation) are corrected in the claims. Support for the added limitation that the particles are --100 nm or less-- may be found in claim 1 as originally filed. Also "combining" is replaced with --connecting-- to clarify that the reactions provide "bridge chains" between particle. Support for this amendment can be found throughout the specification: e.g., paragraph [20] ("[t]hree dimensionally connected bridge chains among silica particles form a networked structure of silica") and paragraph [22] ("[v]arious kinds of functional groups can be employed to form connecting chains").

35 U.S.C. 112 – Definiteness

Claims 1 and 4-29 were rejected under Section 112, second paragraph, as being allegedly "indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention." Applicant acknowledges the Examiner's assistance in clarifying the claimed subject matter.

Claims 1 and 4 are amended to clarify with Markush language to clarify that any of the listed compounds may be used groups and solvents, respectively. Similar amendments are made throughout the set of claims to clarify that at least one of the listed chemicals may be used.

As noted above with regard to support for amendment of claim 1, the phrase "of combining by" is replaced by limitations directed to the size of the particles (i.e., nanoparticles of 100 nm or less) and that the bridge chains "connect" silica particles in three-dimensional networked structure.

Withdrawal of the Section 112, second paragraph, rejection is requested.

35 U.S.C. 102/103 – Novelty and Nonobviousness

A claim is anticipated only if each and every limitation as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Bros. v. Union Oil Co. of Calif.*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). The identical invention must be shown in as complete detail as is claimed. See *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

To establish a case of prima facie obviousness, all of the claim limitations must be taught or suggested by the prior art. See M.P.E.P. § 2143.03. A claimed invention is unpatentable if the differences between it and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art. *In re Kahn*, 78 USPQ2d 1329, 1334 (Fed. Cir. 2006) citing the legal standard provided in *Graham v. John Deere*, 148 USPQ 459 (1966). The *Graham* analysis needs to be made explicitly. *KSR v. Teleflex*, 82 USPQ2d 1385, 1396 (2007). It requires findings of fact and a rational basis for combining the prior art disclosures to produce the claimed invention. See id. ("Often, it will be necessary for a court to look to interrelated teachings of multiple patents . . . and the background knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue"). The use of hindsight reasoning is impermissible. See id. at 1397 ("A factfinder should be aware, of course, of the distortion caused by hindsight bias and must be cautious of arguments reliant upon ex post reasoning"). Thus, a prima facie case of obviousness under Section 103(a) requires "some rationale, articulation, or reasoned basis to explain why the conclusion of obviousness is correct." *Kahn*, 78 USPQ2d at 1335; see *KSR*, 82 USPQ2d at 1396. An inquiry should be made as to "whether the improvement is more than the predictable use of prior art elements according to their established functions." Id. at 1396. But a claim which is directed to a combination of prior art elements "is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." Id. at 1396. Finally, a determination of prima facie obviousness requires a reasonable expectation of success. See *In re Rinehart*, 189 USPQ 143, 148 (C.C.P.A. 1976).

Claims 1 and 4-29 were rejected under Section 102(b) as allegedly anticipated by or, in the alternative, under Section 103(a) as allegedly obvious over Tanaka et al. (U.S. Patent 6,071,997). Applicant traverses because the structure in the cited patent is not the same as, or even similar to, his claimed products.

Applicant's claimed invention is directed to three-dimensionally networked silica that can be used in articles of manufacture as an additive to rubber compounds. To achieve the advantages of his invention, the size of silica particles and the connecting materials between silica particles are patentably distinct as compared to Tanaka. The assertion on page 3 of the Office Action that "limitations set forth in the dependent claims are seen to be conventional process and compositional limitations" is respectfully disputed. As shown in his specification, Applicant's invention exhibits novel and nonobvious characteristics when compared to the prior art.

The reinforcing mechanism of Applicant's claimed networked silica is distinct as compared to Tanaka's connected silica. Moreover, one of ordinary skill in the art would not have had a reason to modify the prior art or a reasonable expectation of success to make the claimed invention. Further, even if prima facie obvious, the networked silica's ability to reinforce rubber compounds is an unexpected result evidencing patentability of the claims. Their preparation methods are also different.

The reinforcing role of silica to rubber is based on the interaction between rubber molecules and the external surface of filler particles. Silica particles should have a large external surface area (relative to the particle's volume) to interact sufficiently with rubber molecules and to result in high reinforcing performance. Therefore, the three-dimensionally networked silica of the claimed invention is prepared using silica particles that are extremely small (e.g., nanoparticles). Accordingly, silica particles used as the reinforcing filler for rubber compounds are composed of nanoparticles in the claims.

Enclosed are research papers discussing reinforcement of rubber compounds by silica particles: Ladouce-Stelandre et al. (Rubber Chem. Tech., vol. 76, pp. 145-159, 2003); Ansarifar et al. (Rubber Chem. Tech., vol. 78, pp. 793-805, 2005); and Kato et al. (Rubber Chem. Tech., vol. 80, pp. 690-700, 2007). The silica used in these publications have particle sizes in the range of about 10-50 nm. The sizes of silica particles used in

Ladouce-Stelandre are 20 nm and 50 nm, those used in Ansarifar are in the range of 20-54 nm, and those used in Kato are around 10-20 nm. They consistently insist on the requirement of nano-sized silica particles for the reinforcement of rubber compounds. Here, the upper limit of particle size is about 100 nm. Fillers with sizes above 1 micron are not suitable for reinforcing rubber compounds in accordance with the claimed invention, but they may be useful as diluents of rubber compounds to reduce the cost associated with expensive materials, especially rubber.

From these considerations, Tanaka's three-dimensionally connected silica is not suitable as the reinforcing material for rubber compounds used in tire manufacturing because its average particle size is above 1 micron. Although the connected silica may be used as a diluent for rubber compounds, it is not suitable as reinforcing filler for the rubber compounds requiring extremely high tensile strength to guarantee the safety and durability of tires. In Tanaka, the silica particles are fused-bound to each other, and this results in reducing the effective surface area accessible to the rubber molecules. Such a reduced surface area causes a reduction in the ability to provide reinforcement in the rubber compounds. Thus, networked silica of the claimed invention is entirely different from Tanaka's connected silica in terms of particle size and application purposes.

The claimed networked silica exhibits a considerably different reinforcing mechanism as compared to conventional silica fillers. Conventional silica filler enhances the tensile performance of rubber components by increasing the interaction between silica particles and rubber molecules. The coupling reagents combining silica particles to rubber molecules significantly increase tensile strength of rubber compounds as well as on their modulus. But the large increase in modulus due to increasing the content of silica and coupling reagent causes significant failure of rubber compounds due to their extreme brittleness. Therefore, the loading of silica in rubber compounds is usually limited up to 80 phr to suppress excessively high increases in moduli. The rubber industry has investigated and studied new coupling reagents to enhance the tensile performance of rubber compounds without significantly increasing their moduli, which causes brittleness.

Silica particles of the claimed networked silica are not directly connected with rubber molecules. Although the interaction between rubber molecules and the external surface of the silica particles contributes to the enhancement of the tensile property of rubber compounds, other reinforcing mechanisms enhance their tensile strength. The enhancement of rubber compounds' tensile strength with network silica is mainly due to the entanglement of rubber molecules with the connecting chains of the networked silica. Entanglement of rubber molecules with the connecting chains of the networked silica enhances their tensile properties without significantly increasing their modulus. This is why the claimed networked silica shows high dispersion in rubber compounds. The different reinforcing mechanism of the networked silica clearly indicates that the development of networked silica is not a simple enhancement of conventional system.

As previously noted, during the process of connecting silica particles to each other, their surface is functionalized, which enhances the affinity of binding between the silica particles and rubber molecules by indirect interactions (i.e., the silica particles and rubber molecules do not directly interact with each other). Thus, an improvement in both dispersion and reinforcing abilities of the silica particles is achieved (see paragraph [10] of the specification).

To Applicant's knowledge, in the prior art's use of silica particles to reinforce rubber compounds, there was no attempt to connect silica particles by organic chains to obtain a three-dimensionally networked structure. Since the organic chains are very thin compared to nano-sized silica particles, many large openings among silica particles are formed in the networked silica. Rubber molecules intrude into such fenestrations and entangle with the organic connecting chains. As shown in Applicant's specification, the reinforcing mechanism based on molecular scale entanglement between the rubber molecules and the organic connecting chains can result in considerable enhancement of the rubber compounds' tensile properties without significantly increasing their moduli. Furthermore, the high dispersion of networked silica particles in rubber compounds also enhances the interaction between rubber molecules and silica particles, resulting in their enhanced tensile properties.

Consequently, Applicant's claimed invention is essentially different from the prior art using silica as a reinforcing filler. These differences are demonstrated in his specification. The claimed networked silica is useful as a reinforcing filler without inducing severe brittleness even at its higher loading. Furthermore, Applicant submits that the connected silica particles prepared in accordance with Tanaka's disclosure cannot have nanometer size and be applied as reinforcing fillers to rubber compounds to enhance their tensile property.

Applicant submits that the features of the claimed invention discussed above are sufficient to distinguish over the cited patent so any other incorrect allegations about Tanaka's disclosure are not disputed here, but the opportunity to dispute them in the future is reserved. Tanaka does not anticipate the claimed invention because it does not disclose all limitations of the claims; similarly, the cited patent does not render obvious the claimed invention because one of ordinary skill in the art would not have had a reason to make the changes necessary to modify Tanaka's disclosure.

Withdrawal of the prior art rejection(s) under Section 102(b)/Section 103(a) is requested because Tanaka does not teach or suggest the claimed invention.

Conclusion

Having fully responded to the pending Office Action, Applicant submits that the claims are in condition for allowance and earnestly solicit an early Notice to that effect. The Examiner is invited to contact the undersigned if any further information is required.

Respectfully submitted,

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